Soil Algae of Northwest Florida

Jon H. Arvik

Reports on the algal flora of Florida have been primarily discussions of particular taxons (Brannon, 1945, 1952) or regions (Nielsen and Madsen, 1948, 1948a; Crowson, 1950) or are truly taxonomic works in somewhat greater detail (Nielsen, 1954, 1954a, 1955, 1955a, 1956; Nielsen and Madsen, 1956, 1956a). Studies of Florida soil algae were made by Smith and Ellis (1943) and Smith (1944); however, these were concerned with characterization of an algal ecosystem rather than taxonomy. The works of Tilden (1910) and Drouet (1968) also include information on Florida algae.

Approach

This investigation was undertaken to provide a portion of a continuing program of ecological research sponsored by the Air Force Armament Laboratory, Eglin AFB, Florida. The Eglin Reservation, occupying approximately 750 square miles in northwestern Florida, was the study area. Eglin is bounded by Alaqua Creek to the east, the Yellow River to the west and north, Choctawhatchee Bay to the south, and includes portions of the Southern Coastal Plain and Gulf Coast Flatwoods. Soil types vary considerably in the area (Huckle and Weeks, 1965), but are generally moderately thick acid sands of either Lakeland-Eustis-Blandon or Lakeland-Eustis-Norfolk association (Smith et al., 1967).

The specific sampling areas included forested areas of longleaf pine (*Pinus palustris* Mill.), sand pine (*P. clausa* Chapm. Vasey), and turkey oak (*Quercus laevis* Walt.), reforested areas planted to slash pine (*P. elliotti* Englm. var. elliotti), and areas mechanically cleared and left untended. Creeks, ponds and lowland swamps were not included.

Ten sites of 0.01 acre each were selected throughout the Reservation. None of the sites had a history of herbicide treatment. Collections were made in September, 1967, January, March, June, August, and October, 1968. Samples were taken from two levels in the soil. Level A included the litter of the surface and the first centimeter of soil. Level B samples were an amalgam of the soil

between one and 15 cm. Samples were taken with sterile wooden tongue depressors and were transported to the laboratory in sterile disposable dishes. Approximately 100 grams of soil were collected from three random points in each site on each sample date. In the laboratory, the soil was divided to provide four cultures from each original sample.

The moist plate culture method of Willson and Forest (1957) was used with slight modifications. Sterile filter paper was placed in 100 mm sterile disposable Petri dishes, after which approximately 25 gm of the sample soil were added. The algae were cultured with sterile Bristol's solution under fluorescent lights in 12-hour light/dark cycles at 300 foot-candles. Temperatures were allowed to vary ± 3 C from 25 C. The second method of culture preparation was identical to the first except an additional piece of sterile filter paper was placed directly on the culture soil and moistened with the nutrient solution. Many algal forms grew through the paper, permitting easier observation of gross colony morphology and aiding isolation of the organisms into cultures. Standard isolation techniques were used to obtain unialgal or axenic cultures of the green algae. Life cycle studies as described by Starr (1955), Deason and Bold (1960) and others were performed as required to determine the species of selected organisms. No effort was made to obtain pure cultures of the bluegreen algae.

Results and Discussion

Thirty-eight organisms were identified. Thirteen of the Chlorophyta and three of the Cyanophyta were unicellular forms. Algae located in every sample included at least one species of each of the genera *Chlamydomonas, Chlorococcum, Chlorella, Microcoleus, Nostoc, Oscillatoria,* and *Schizothrix.* In the great majority of cases, *Chlorococcum, Nostoc,* and *Schizothrix* were represented by two or more species. Presumably because of seasonal variations and lower population densities, most of the other algae were located sporadically through the sampling period, but few were not universally distributed on all sample plots or in both sample levels. A species of *Spongiococcum* was the only alga found repeatedly in a single location, though *Rivularia* was cultured only once in the entire study.

The dominant genus in terms of biomass in culture was *Nostoc.*

Two of the three species located in the study were present in every culture, *N. muscorum* Ag. and *N. ellipsosporum* (Desmaz.) Rabenh. The most frequently located alga was *Schizothrix calcicola* (Ag.) Gom. This is probably the case in most previous studies of soil algae, since a recent monograph has transposed the majority of the family Oscillatoriaceae into that species (Drouet, 1968). A complete listing of the algae identified in this study is as follows:

CHLOROPHYTA, Family Chariaceae

Characium ambiguum Herm.
Characium sp.

Family Chlamydomonadaceae

Chlamydomonas pyrenoidosa Deason and Bold
C. typica Deason and Bold

Family Chlorococcaceae

Chlorococcum ellipsoideum Deason and Bold
C. diplobionticum Hern.
Spongiococcum sp.

Family Euglenaceae

Euglena sp.

Family Mesotaeniaceae

Cylindrocystis Brebissonii Menegh.

Family Oocystaceae

Chlorella vulgaris Beyer.
Chlorella sp.

Family Protodermataceae

Protococcus viridis C. A. Agardh.

Family Scenedesmaceae

Scenedesmus sp.

Family Ulotrichaceae

Hormidium subtilissimum Mattox and Bold
H. flaccidum Mattox and Bold
Stichococcus bacillaris Naeg.
S. subtilis (Kuetz.) Klerk.
Ulothrix tenerrima Kuetz.

Family Zygnemataceae

Zygogonium ericetorum Kuetz.

CYANOPHYTA, Family Chroococcaceae

Anacystis marina Drouet and Daily
Coccochloris aeruginosa Drouet and Daily
C. peniocystis Drouet and Daily

Family Nostocaceae

Nodularia sp.
Nostoc commune Vauch.

N. ellipsosporum (Desmaz.) Rabenh.
N. muscorum Ag.

Family Oscillatoriaceae

Arthrospira brevis (Kuetz.) Drouet
Microcoleus lyngbyaceus (Kuetz.) Drouet
M. vaginatus (Vauch.) Gom.
Oscillatoria lutea Ag.
O. submembranaceae Ar. and Straff
Porphyrosiphon Notarisii (Menegh.) Gom.
Schizothrix arenaria (Berk.) Gom.
S. calcicola (Ag.) Gom.
S. Friezii (Ag.) Gom.

Family Rivulariaceae

Calothrix parietina (Naeg.) Thuret.
Rivularia sp.

Family Stigonemataceae

Fischerella ambigua (Naeg.) Gom.

Soil populations are by nature unstable and respond to changes in moisture, nutrient and mineral content of the soil, light availability to the organisms, distribution and densities of species in the soils, and other factors, including pH and soil type. In studies of North Carolina pine forest soils, Jurgensen and Davey (1968) found an inverse relation between algal numbers and soil pH. They could not culture nitrogen-fixing algae from soils with a pH of 5.4 and lower, though algae of this type were located in abundance from all samples of Eglin pine stand soils with a pH range from 5.0 to 5.4. These algae included *Nostoc muscorum*, *N. ellipsosporum*, *N. commune*, *Calothrix parietina*, and others. However, it has been demonstrated that nitrogen fixation does not occur below a pH of approximately 5.7 (Allison et al., 1937, Fogg, 1947), so though these algae are present, they are limited in what should be their major contribution to a soil ecosystem.

Smith (1944) attempted to determine the algal flora of several different Florida soil types. The Norfolk fine sand flora of his study and the Eglin Norfolk flora generally agree. In some cases where the algae located by Smith were not located in this study, closely related algae were cultured. For example, Smith found *Mesotaenium*, a saccoderm desmid; we did not observe this alga, but did find *Cylindrocystis*, also a member of the Mesotaeniaceae.

It is probable that a characteristic microflora may be found associated with a given soil type, just as the macrovegetation of a

region is influenced by the soil. Since the sample areas of this study were chosen for their similarity, no qualitative variations in the algal flora were attributed to differences in soils. Thus, the list of algae located during the study is a composite from all of the sample sites.

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Project Scientist, Biological Branch, Air Force Armament Laboratory, Eglin AFB, Florida. Present address: *Weed Research Laboratory, Colorado State University, Ft. Collins, Colorado 80521.*